REMARKS

The above preliminary amendment is made to make minor editorial corrections to the specification and claim 10.

Applicants respectfully request that the preliminary amendment described herein be entered into the record prior to examination and consideration of the above-identified application.

If a telephone conference would be helpful in resolving any issues concerning this communication, please contact Applicants' primary attorney-of record, Douglas P. Mueller (Reg. No. 30,300), at (612) 371.5237.

Respectfully submitted,

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By ____________________
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DPM/tvm

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IN THE SPECIFICATION

Please amend the following paragraph beginning on page 8, line 25:

FIG. 1 is a schematic view to show a structure (atom position at a time of crystallization) of a representative recording film used for an information recording medium of the present invention, in which the crystalline phase is a single phase. In this example, the crystalline phase is constituted with a single compound phase (moreover, it is a rock-salt type structure). In the lattice site position forming the rock-salt type structure, all 4a sites are occupied by Te atoms 1, while 4b sites are occupied by Ge atoms 2, Sb atoms 3, and occupied randomly by also lattice defects 4. In the present invention, atoms other than the atoms occupying the 4b sites are filled in the lattice defects.

Please amend the following paragraph beginning on page 10, line 7:

FIG. [2] 4 is a cross sectional view to show an example (layer constitution) of an optical information recording medium according to the present invention. A typical information recording medium is constituted by forming a recording layer 8 having the above-mentioned constitution on a substrate 7 selected from transparent polycarbonate resin, an acrylic resin, a polyolefin-based resin, a glass sheet or the like. Protective layers 9 and 10 can be formed on at least one surface of the recording layer. Reflective layers 11 can be formed on the respective protective layers. Overcoats 12 can be formed on the top layers, or the overcoats can be replaced by protective plates 14 that are adhered by adhesive layers 13. For guiding laser beams used in recording/reproducing, a spiral or concentric circular concave-convex groove track, a pit array, a track address can be formed on the substrate surface. Such a recording medium is irradiated with

a laser beam in order to cause reversible phase change in the recording layer between a crystalline phase and an amorphous phase, so that information can be rewritten. In the case of crystallization, the recording medium is irradiated with a laser beam like a pulse in order to keep the irradiated part at or above an interim crystallization change temperature. In changing the recording layer to be amorphous, the layer is irradiated with a more intensive laser beam for a period equal to or shorter when compared to a case of crystallization, so that the irradiated part is melted instantaneously and then quenched. This reversible phase change can be detected as a change in the reflectance or transmittance. This reproduction is carried out by irradiating the recording medium with a laser beam weakened not to provide any additional influence so as to detect changes in the strength of light reflected from the irradiated portion or transmitted.

Please amend the following paragraph beginning on page 10, line 33:

An optical information recording medium according to the present invention, as shown in FIGs. 4A-4J, will be characterized by a composition of a material composing the recording layer 8 and by the internal structure. A representative example will be explained below with reference to a Ge-Sb-Te based material. As reported in N. Yamada et al., J. Appl. Phy.69(5), 2849 (1991), a Ge-Sb-Te material is crystallized to have a face-centered cubic structure meta-stably by irradiating a laser beam. In addition to that, a recent research presentation by the same author (MRS-Buttetin, 21(9), 48(1996) and a research presentation by Nonaka et al. (papers for the tenth symposium on phase change recording, p.63) suggest that the metastable phase necessarily contains many lattice defects (vacancy). The following description is about a representative composition of a stoichiometric compound composition of $Ge_2Sb_2Te_5$. The material has a metastable phase of rock-salt type (NaCl type). As shown in FIG. 1, all lattice

positions (4a sites) corresponding to Cl atoms are occupied by Te atoms 1, and all lattice site positions (4b sites) corresponding to Na atoms are occupied by Ge atoms 2 and Sb atoms 3 at random depending on the composition ratio. However, since the total number of the Ge atoms and the Sb atoms is greater than the number of the Te atoms, the [4a] 4b sites necessarily has lattice defects 4 of about 20% (about 10% of the entire sites). The lattice defects also are located at random (An example of atom positions in 4a sites is shown).

Please amend the following paragraph beginning on page 13, line 32:

As a result of various analyses and experiments, the inventors have found that not all elements can fill lattice defects and that an ionic radius is an important factor to determine the conditions. When the 4a sites have lattice defects, the defected lattices of the base materials will be filled easily if Rim is sufficiently close to Rnc, where Rnc denotes an ionic radius of an element having a minimum ionic radius among elements occupying the 4a sites and Rim denotes an ionic radius of an additional element. According to Third Revision of Manual of Basic Chemistry (Kagaku-binran Kiso-hen) II issued by Maruzen Co., Ltd., the radius of a Ge^{4+} ion is 0.67nm, the radius of a Sb^{5+} ion is 0.74[μm]nm, and the radius of a Te^{2-} ion is 2.07[μm]nm when the coordination number is 6. For Ge-Sb-Te, an element can enter a lattice easily when it has an ionic radius substantially the same or slightly smaller than the radius of a Ge ion located at a [4a] 4b site. Each Ge ion has a smaller ionic radius than that of a Sb ion.

Please amend the following paragraph beginning on page 16, line 1:

Atoms in a rock-salt structure are considered to have a coordination number of 6. Table 1 is a list of ion species each having a coordination number of 6 and ionic radius of

about 0.67nm in an order of the ionic radius. Since a Ge^{4+} ion has ionic radius of 0.67nm, ions ranging from a vanadium ion V^{5+} that is about 70% of a Ge^{4+} ion to a Ni^{3+} ion that is about 105% may enter a lattice. That is, effective elements are V, S, Si, P, Be, As, Se, Ge, Mn, Re, Al, Co, Te, Cr, and Ni. Among them, V, S, Si, Mn, Al, Co, Cr, and Ni etc. are suitable. The remaining elements are not suitable, since, for example, Be, As and P may cause problems due to the toxicity, while Ge and Te compose the base material, and Re is a radioactive element.

Please amend the following paragraph beginning on page 21, line 28:

Interface layers 16 and 17 can be formed in an interface between the recording layer and at least one of the protective layers for several purposes, such as preventing atomic diffusion in spacing between the recording layer and the protective layer. Especially, nitrides, nitride-oxides and carbides are suitable for the interface layer. The examples include materials of Ge-N-(O), Al-N-(O), Si-C-N, Si-C or the like, and materials further including Cr, Al or the like, such as Ge-C-N and [Si-Al-] Si-Al. Optical absorption Aa of a recording layer in an amorphous state can be decreased relatively with respect to optical absorption Ac of the recording layer in a crystalline state by applying an optical absorption layer 18 over an upper protective layer of the recording layer, or by applying a semitransparent reflecting layer 19 at the light incident side of the recording layer.

Please amend the following paragraph beginning on page 25, line 1:

The increase of the crystallization temperature becomes sharp when the Al concentration is at a level of the sample [E] A5. For this composition, Ddf (concentration of

lattice defects) occupies 10% of the whole sites (20% of the 4b sites). For the respective samples, ratios that Al atoms fill lattice defects to Ddf are as follows: A1:0, A2:0.2 × Ddf, A3:0.5 × Ddf, A4:1.0 × Ddf, A5:1.5 × Ddf, A6:2.0 × Ddf, A7:2.5 × Ddf, and A8:3.0 × Ddf. For the samples A5-A8, there are more Al atoms than the lattice defects to be filled. Percentage of the Al atoms to the whole compositions in the respective samples are as follows. A1: 0%, A2: 2.2%, A3: 5.3%, A4: 10%, A5: 14.3%, A6: 18.2%, A7: 21.7%, and A8: 25%.

Please amend the following paragraph beginning on page 29, line 27:

Various additives other than Al were added to $Ge_2Sb_2Te_5$ recording films for the purpose of examining the recording performance of the films. Additives were selected from elements having ion radii similar to an ionic radius of Al, i.e., V, S, Si, P, Se, Ge, Mn, Re, [Al,] Co, Te, Cr, Ni; elements having melting points similar to that of Al, i.e., Sb, Pu, Mg, [Al,] Ba; and elements of a separate group, i.e., Ag, Pb, and Sn. Each additive of about 5 atom% was added for examining the effects.

Please amend the following paragraph beginning on page 32, line 24:

In accordance with Examples 12 and 13, 1000 kinds of optical disks were manufactured in which the composition is represented by $[(Ge + Sn)_4Sb_2Te_7]_{(100y-z)}Cr_yAg_z$. In the composition, x indicates a percentage of Sn in the entire composition and y [indicates] and z indicate atom%. The values of x, y and z were varied in the following range:

x = 0, 1, 2, 3, 4, 5, 8, 10, 15, 20%

y = 0, 1, 2, 3, 4, 5, 8, 10, 15, 20%

z = 0, 1, 2, 3, 4, 5, 8, 10, 15, 20%.

The thickness of the respective layers and evaluation criteria are identical to those of Examples 12 and 13. It was confirmed that equivalent or better performance was obtainable for all the three criteria when the Sn concentration was in a range from 3% to 15%, the Cr concentration was in a range from 1% to 5%, and the Ag concentration was in a range from 1% to 10%. It was effective especially in improving signal amplitude, stability of rewiring sensitivity and repeatability when the Sn concentration was in a range from 5% to 10%, the Cr concentration was in a range from 1% to 3%, and the Ag concentration was in a range from 1% to 3%.

IN THE CLAIMS

Please amend the following claim:

10. (Amended) The information recording medium according to claim 9, wherein the crystal structure comprising the lattice defect further comprises at least one combination of elements selected from Sn-Cr, Sn-Mn, Sn-Ag, Mn-Ag, Cr-Ag, [Sn-Mn,] and Sn-Cr-Ag.